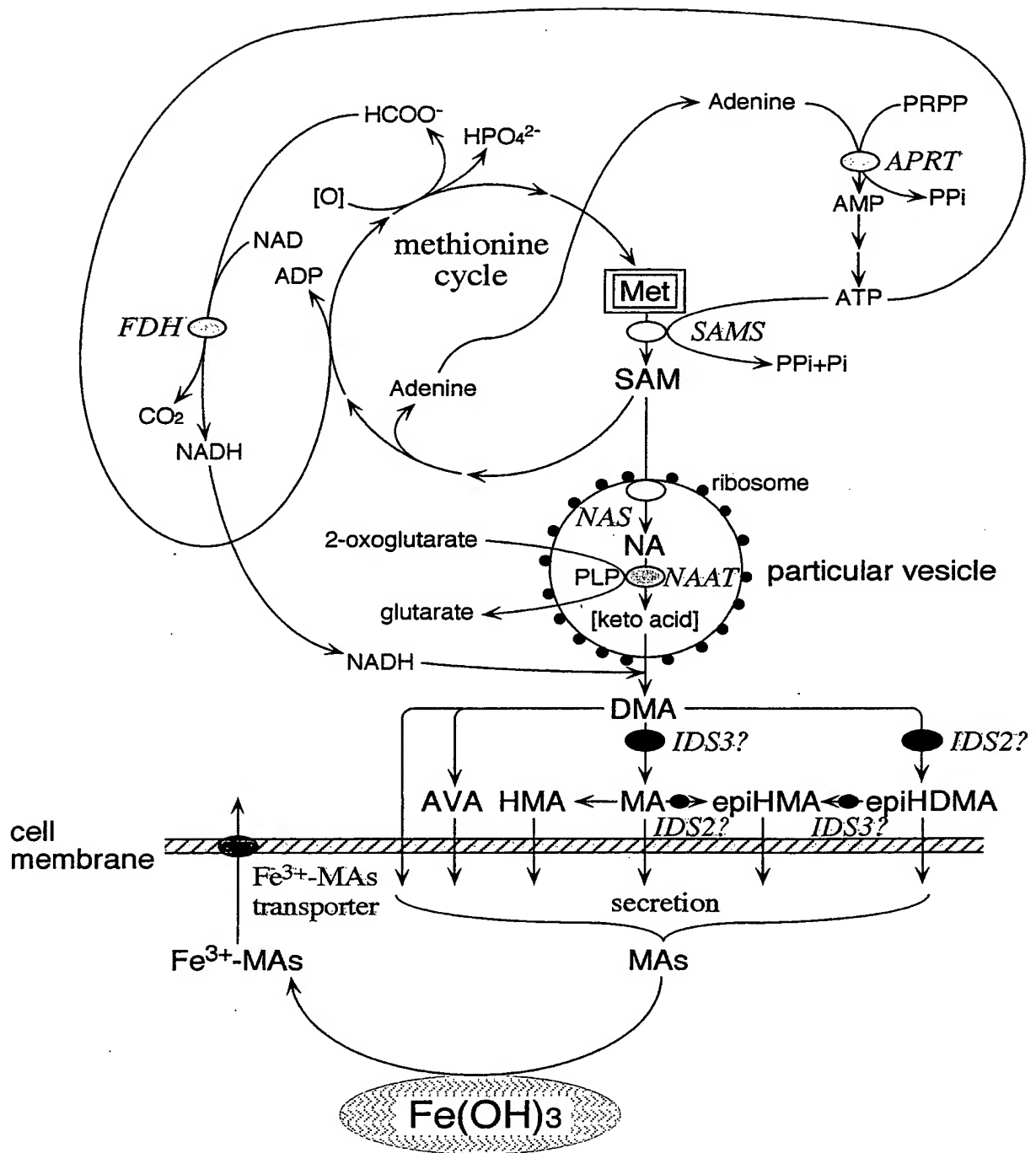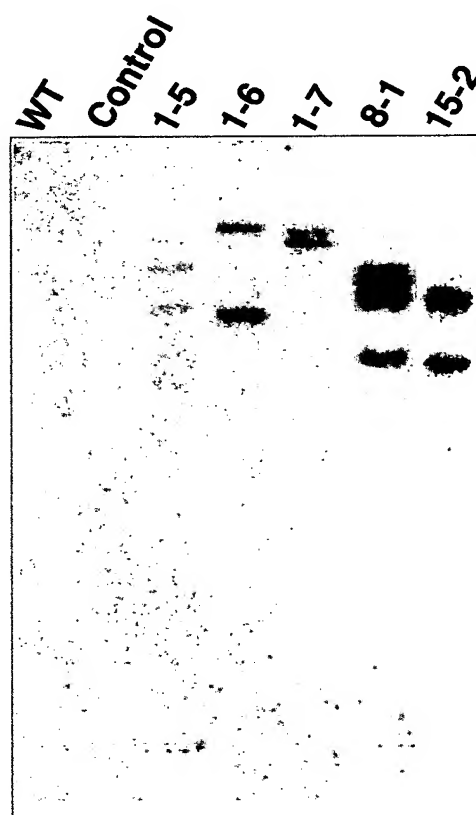F I G. 1

F I G. 2

FIG. 3

F I G. 4

FIG. 5

F I G. 6

F I G. 7

13.5 kb
N

10.4 11.0
N

B
N
D

9.5
E

C

6.1
E

5.3 5.5
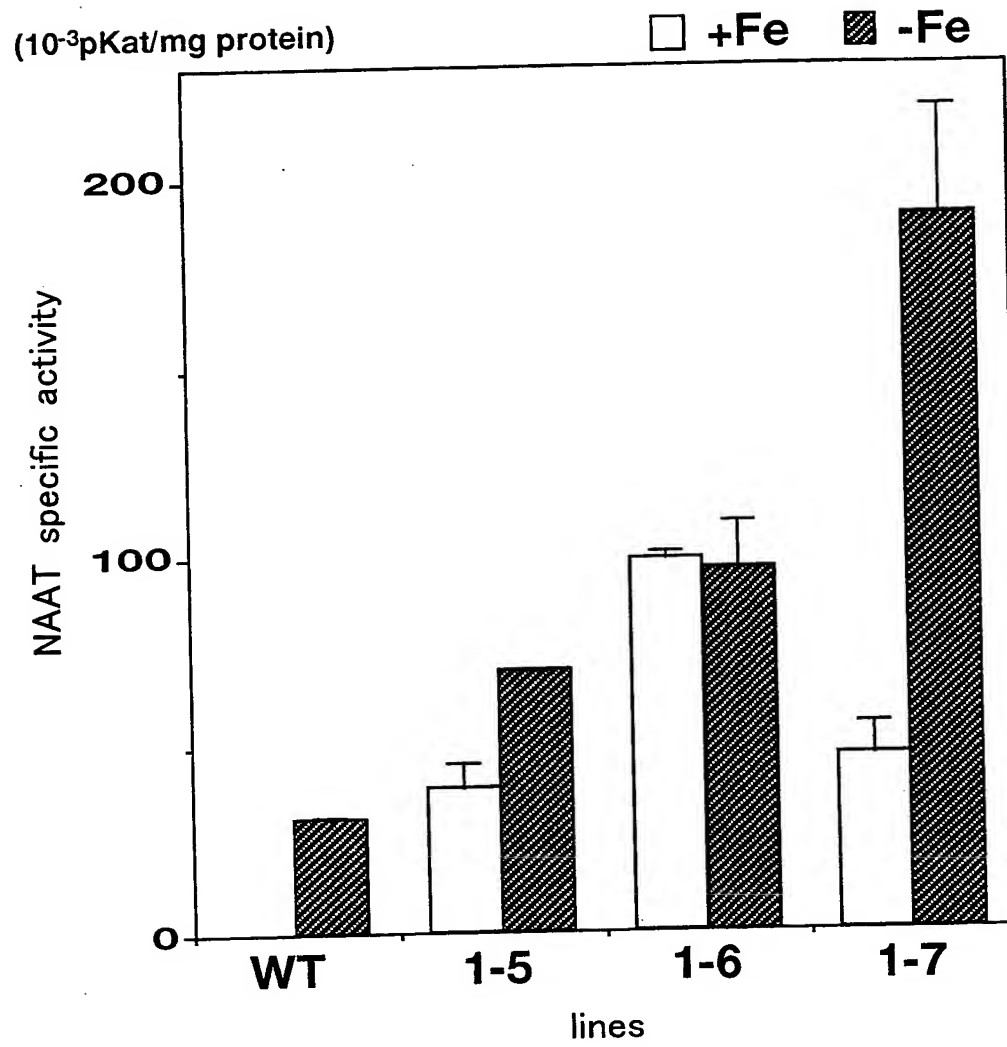H H

B

1.9
E

A
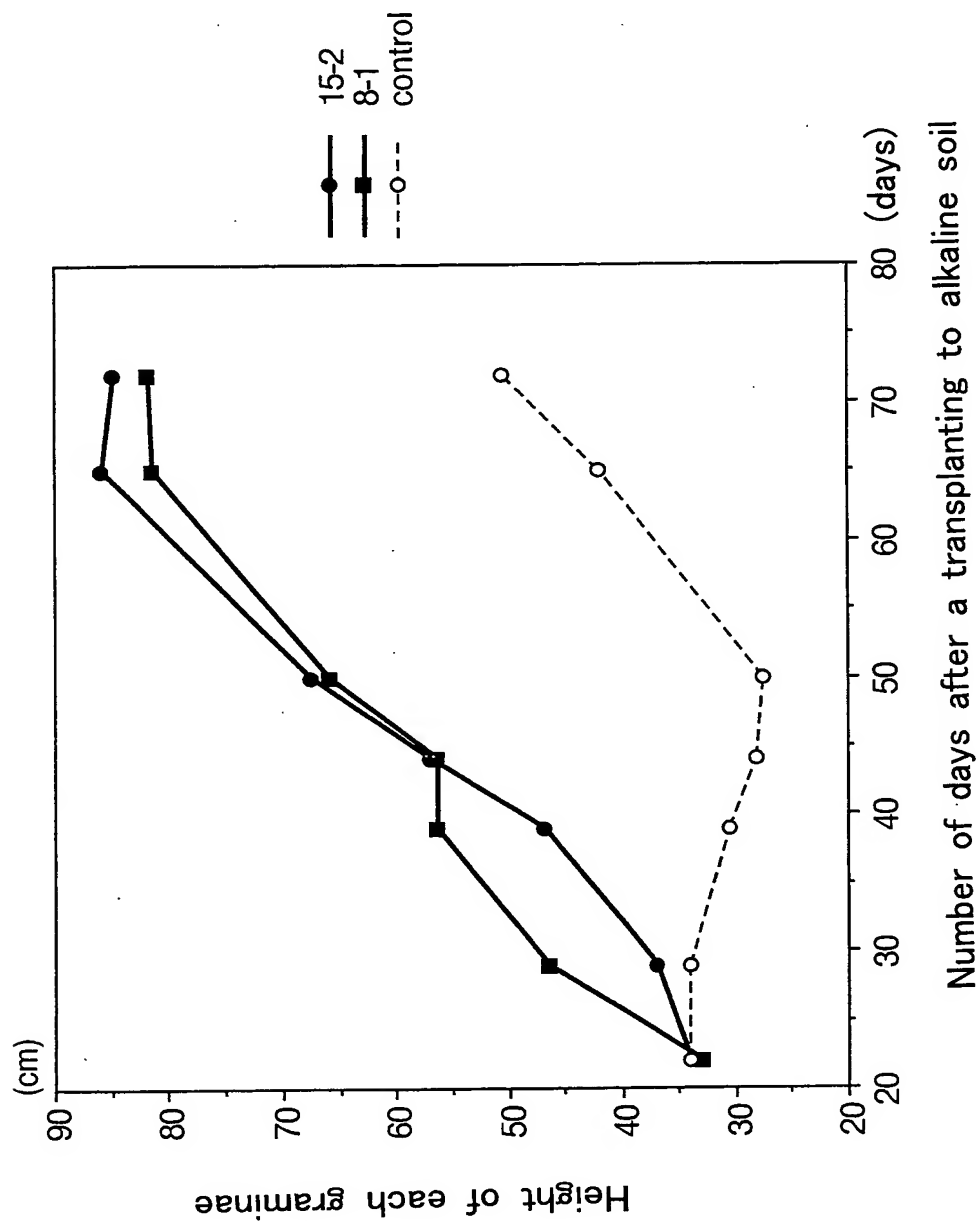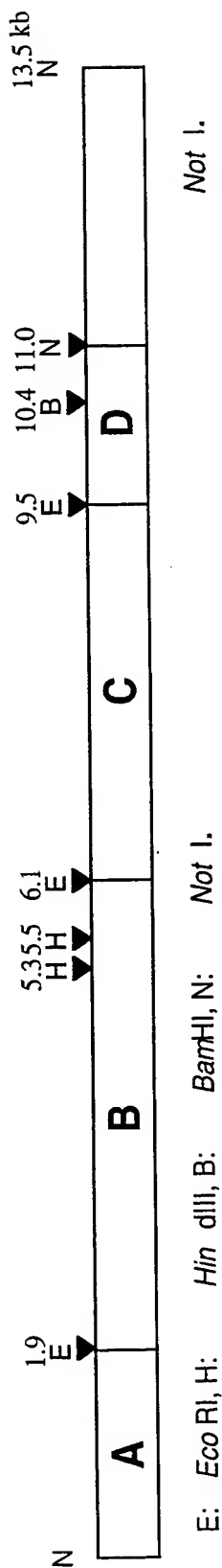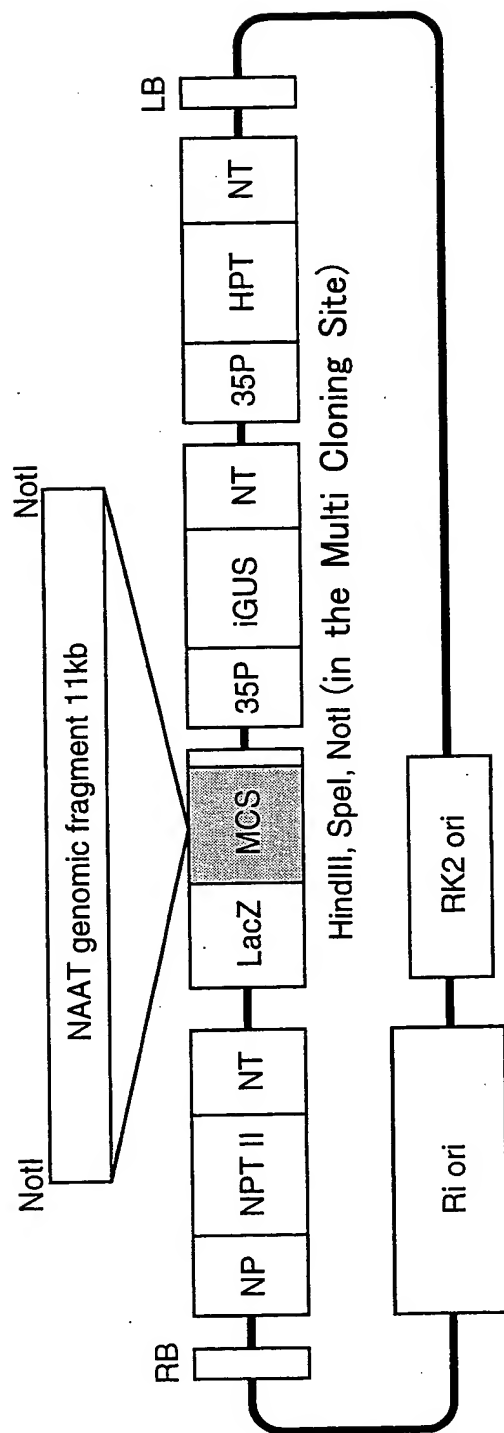
N

E: *Eco* RI, H: *Hin* dIII, B: *Bam*HI, N: *Not* I.

The *Not* I site on both sides is the *Not* I located at the arm of λFIX II

F I G. 8

FIG. 9

CTCGATCCCATTGCAATGGTATGATTAGCTATCAAACGAAAGAAAGAGATGGCATGTGCC
CTGTGTGTCATCCCTCACTGGCTTGGCGAATGGCGATACCGAGTTAGGTAGAGTGTTTTT
TTAGCATGATGTCTGCCGGCACTGCCAAGAAAACTGCGTGCAGCGGACTGCAGGAGAGTT
GAGCGATGCATGCTTTGTGATGAGCGGAGCTGAGTGGGTGTCACTAACTGAACCCAATCA
GCATTGGGTGAGTCGAGTCGAGAAGCATCATGCTTCCTGCGTCCCGATCCGCTTATCTTT
TTCTCCCAAATTATTAAAGAGGGATAGATGATGGTGTGCTGGGTTGGGTAGAGTACGTGC
ATAGAACCAAAGCGAGGCGCCGAAAATATGCCGGGGATAATGGTGGCAGGCCGCAACGGC
CACGCCCGTCAGCTGGCAGCGGCGTGCCAGAGCGTGCCAGAGCGTGCGCGCGTGCGTGCT
TCTTGCTGCCGGCCCCGGTTCGTGTGCGGTCAGAGCAACGGCTATATAGGACCGTCAATC
ACCGCTACTCAATCCGTCCCCAACTCGTTTCCTATTACCGCTACTAGTAGTATTCCTGGT
GTAGTCTAGTAGTACTCCTCCTCCTCCTTCTCCTCCTACCCGTTTCCTCATGGCCACCGT
ACGCCAGAGCGACGGAGTCGCCGCGAACGGCCTTGCCGTGGCCGCAGCCGCGAACGGCAA
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TGCCGACGCGAACGGCAAGAGCAACGGCCATGGCGTGGCTGCCGACGCGAACGGCAAGAG
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CAACGGCCACCGCGAGAGCAACGGCCATGCTGAGGCCGCCGACGCGAACGGCGAGAGCAA
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AGAGGAGGAGGAGGCGGTGGAGTGGAATTTCGCGGGTGCCAAGGACGGCGTGCTGGCGGC
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GAAGGGGCCGCGGCCCGTGCTGCCGCTGGCCCACGGGGACCCGTCCGTGTTCCCGGCCTT
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GTCGCAGGGCGTGCCGTACATGCTATCGGCCGACGACGTCTTCCTCACCGCCGGCGGGAC
CCAGGCGATCGAGGTCATAATCCCGGTGCTGGCCCAGACCGCCGGCGCCAACATTCTGCT
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CGCCGACAAGAACACCACCGCCATGGTCATCATAAACCCCAACAACCCGTGCGGCAGCGT
TTACTCCTACGACCATCTGTCCAAGGTTTCACATCCTTTGCCTTGCTGAATATGGATTCA
GTTCAGTGCACCTGCTGAATTCTTTTTGCCAATCGCATACTGACTGATGTTGCTCAATTA
GGTCGCGGAGGTGGCGAAAAGGCTCGGAATATTGGTGATTGCTGACGAGGTATACGGCAA
GCTGGTTCTGGGCAGCGCCCCGTTCATCCCAATGGGAGTGTTTGGGCACATCACCCCTGT
GCTGTCCATAGGGTCTCTGTCCAAGTCATGGATAGTGCCTGGATGGCGGCTTGGATGGGT
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GCGCACCGGCCAGTTCAACTGCTACGCCGCCGGCGTCGGCCTCCCCGCCGCACGAAGGTA
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CATTATTGTTCTCTTATGATTCACACAACTTAATTATGGATTTTTGTGCTATCAAATTGT
TTAGGAAGCTCTTCCTAAAATTCTTGAGAACACAAAAGCAGATTTCTTTAAGAGGATTAT
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TATGTTTTGCTATGGATCTTTTTGAAGATGCATGCATTTGAAGAATAATGAAGAGAGTTG
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ACAATTTTATACTAGATCTAGTACAAAGTTGAAACAGTTATTTTGGGACAGAGGGAGTAG
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CATGTTCTCTTATGTTTTTTGATTGTATACGAAGTTCTTATCAGTTTCCGAGATGACTAC
ACATAAATGATTACCATATCATTGTCAGAAAATGTATTACCACATTAGAATATTCTTTCT
TTTTATGCAAAGACTAGCATGGCATGTACTTTTCCTTGTACCTATGTGTCTTTTTTTTTC
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ATCCCCATTTATATATTTCAATAAAACATATTGTAATGGTTCTGTTGTAGCTGTCCAAGT
CATGTACTCTACTTTTTGATGTATTTGGCCTCATTGCCTTGCATCAGTTTCAATAAAAAT
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CTATATCTTTCAACAAATGAAACCTTGAGTTCCCTTTGAGTAGAAGTCAACATACTCCTT
GAATATGCTATGGTTTCCATGGTCTGGATGAAACATGATGAATAGAAGTGAAGTTATATC
CATGTCAAAGTTTTTTAATGTTTAATTTCATTATGAGAACTTTGATATTACTTCTAGCAC
ACATTCTCTGAAGTAATTGTCAGTTTGGTACTTGAAGGGACCTATATTTTTCCTATTGGG
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TCAAGGGATACAATCATAATGAGTACACAATCGACATCTACATAATCAGGTTGCATACGG
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TACCTGGCAAAGGCGGATTCAAGCCCCAGACAGCCTGGGCGGCCGC
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FIG. 10

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ctcgatcccattgcaatggtatgattagctatcaaacgaaagaaagagatggcatgtgcc
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tcttgctgccggccccggttcgtgtgcggtcagagcaacggctatataggaccgtcaatc
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GTAGTCTAGTAGTACTCCTCCTCCTCCTTCTCCTCCTACCCGTTTCCTCATGGCCACCGT
                                                 M   A   T   V   NAAT-B


ACGCCAGAGCGACGGAGTCGCCGCGAACGGCCTTGCCGTGGCCGCAGCCGCGAACGGCAA
  R   Q   S   D   G   V   A   A   N   G   L   A   V   A   A   A   A   N   G   K


GAGCAACGGCCATGGCGTGGCTGCCGCCGTGAACGGCAAGAGCAACGGCCATGGCGTGGA
  S   N   G   H   G   V   A   A   A   V   N   G   K   S   N   G   H   G   V   D


TGCCGACGCGAACGGCAAGAGCAACGGCCATGGCGTGGCTGCCGACGCGAACGGCAAGAG
  A   D   A   N   G   K   S   N   G   H   G   V   A   A   D   A   N   G   K   S


CAACGGCCATGCCGAGGCCACTGCGAACGGCCACGGCGAGGCCACTGCGAACGGCAAGAC
  N   G   H   A   E   A   T   A   N   G   H   G   E   A   T   A   N   G   K   T


CAACGGCCACCGCGAGAGCAACGGCCATGCTGAGGCCGCCGACGCGAACGGCGAGAGCAA
  N   G   H   R   E   S   N   G   H   A   E   A   A   D   A   N   G   E   S   N


CGAGCATGCCGAGGACTCCGCGGCGAACGGCGAGAGCAACGGGCATGCGGCGGCGGCGGC
  E   H   A   E   D   S   A   A   N   G   E   S   N   G   H   A   A   A   A   A


AGAGGAGGAGGAGGCGGTGGAGTGGAATTTCGCGGGTGCCAAGGACGGCGTGCTGGCGGC
  E   E   E   E   A   V   E   W   N   F   A   G   A   K   D   G   V   L   A   A


GACGGGGGGCGAACATGAGCATCCGGGCGATACGGTACAAGATCAGCGCGAGCGTGCAGGA
  T   G   A   N   M   S   I   R   A   I   R   Y   K   I   S   A   S   V   Q   E


GAAGGGGCCGCGGCCCGTGCTGCCGCTGGCCCACGGGGACCCGTCCGTGTTCCCGGCCTT 1200
  K   G   P   R   P   V   L   P   L   A   H   G   D   P   S   V   F   P   A   F


CCGCACGGCCGTCGAGGCCGAGGACGCCGTCGCCGCCGCGCTGCGCACCGGCCAGTTCAA
  R   T   A   V   E   A   E   D   A   V   A   A   A   L   R   T   G   Q   F   N


CTGCTACCCCGCCGGCGTCGGCCTCCCCGCCGCACGAAGgtaacaacaacaacaacacaa
  C   Y   P   A   G   V   G   L   P   A   A   R   S


gaacaatttccttttcgcgtgtcgtgtcgcgcggcaatccatgcatgcgcatgtgccgct
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gaccttctcccaccttataccaaacaaaacaaaaaaacacagCGCCGTGGCAGAGCACCT
                                            A  V  A  E  H  L

GTCGCAGGGCGTGCCGTACATGCTATCGGCCGACGACGTCTTCCTCACCGCCGGCGGGAC
 S  Q  G  V  P  Y  M  L  S  A  D  D  V  F  L  T  A  G  G  T

CCAGGCGATCGAGGTCATAATCCCGGTGCTGGCCCAGACCGCCGGCGCCAACATTCTGCT
 Q  A  I  E  V  I  I  P  V  L  A  Q  T  A  G  A  N  I  L  L

CCCCAGGCCAGGCTACCCAAACTACGAGGCGCGCGCCGCGTTCAACAGGCTGGAGGTCCG
 P  R  P  G  Y  P  N  Y  E  A  R  A  A  F  N  R  L  E  V  R

GCATTTCGACCTCATCCCCGACAAGGGGTGGGAGATCGACATCGACTCGCTGGAATCCAT
 H  F  D  L  I  P  D  K  G  W  E  I  D  I  D  S  L  E  S  I

CGCCGACAAGAACACCACCGCCATGGTCATCATAAACCCCAACAACCCGTGCGGCAGCGT  1800
 A  D  K  N  T  T  A  M  V  I  I  N  P  N  N  P  C  G  S  V

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 Y  S  Y  D  H  L  S  K

gttcagtgcacctgctgaattctttttgccaatcgcatactgactgatgttgctcaatta
gGTCGCGGAGGTGGCGAAAAGGCTCGGAATATTGGTGATTGCTGACGAGGTATACGGCAA
 V  A  E  V  A  K  R  L  G  I  L  V  I  A  D  E  V  Y  G  K

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 L  V  L  G  S  A  P  F  I  P  M  G  V  F  G  H  I  T  P  V

GCTGTCCATAGGGTCTCTGTCCAAGTCATGGATAGTGCCTGGATGGCGGCTTGGATGGGT
 L  S  I  G  S  L  S  K  S  W  I  V  P  G  W  R  L  G  W  V

AGCGGTGTACGACCCCAGAAAGATCTTACAGGAAACTAAGgtacttaaatctctatatca
 A  V  Y  D  P  R  K  I  L  Q  E  T  K

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                        I  S  T  S  I  T  N  Y  L  N  V  S

CAGACCCAGCAACCTTCATTCAGgtcagtctttggtatttacctcgtttcaagaaataaa
T  D  P  A  T  F  I  Q

gtctttggtatttactcctccttgtcctattttgctccggtccctatgttgtaggcagcc  2400
cacgtgcatgtcaagtgaccgttttttcacattaagtttgaaagtcaaagtcagacacat
acacttgtagttattttacctttgtttgctttgatccgataaaataaaaaaatacaaaaa
ctgaacctactgttgaatataaccactgttcttacaagatatacatgattgcactatggg
catgccatattcttttgggtcaagtatgcagtatgttggaacctcttttagaaaatagat
acattgtactatgagtataccattttattaagaatttcatattttgatatccttgatggt
attgttctcttgtgattcacacgatttacttgtggttttttgtactatcaaattgttcag
GCAGCTCTTCCTCAGATTCTTGAGAACACAAAGGAAGATTTCTTTAAGGCGATTATTGGT
 A  A  L  P  Q  I  L  E  N  T  K  E  D  F  F  K  A  I  I  G
```

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```
CTGCTAAAGGAATCATCAGAGATATGCTACAACAAATAAAGGAAAACAAATACATTACA
 L  L  K  E  S  S  E  I  C  Y  K  Q  I  K  E  N  K  Y  I  T
```

```
TGTCCTCACAAGCCAGAAGGATCAATGTTTGTCATGgtaagcctatttttgtgaagtaaaa
 C  P  H  K  P  E  G  S  M  F  V  M
```

```
aaatcttagggagtgtcagtaatcataaacttatttatataggattaatctgggaccgaa      3000
atgcatccaacataattacttcaaattcaaattcaaattacattcttccgtacatatttt
tgaagatgcatgtatttttaagaataatgacgagagctaaagttatgctacgactaatcat
ctggatatcctttgtccatctttttgttatactgtggaatgttaatggtcaaatcatatt
acacaaatatccatgctagtttctagaaagattgattattttctgtaaccatgaactcc
gtattaacttccatgtaaacagGTGAAACTGAACTTACATCTTTTGGAGGAAATAGACGA
                       V  K  L  N  L  H  L  L  E  E  I  D  D
```

```
TGACATTGATTTTTGCTGCAAGCTCGCAAAAGAAGAATCAGTAATCTTATGCCCAGgtag
 D  I  D  F  C  C  K  L  A  K  E  E  S  V  I  L  C  P
```

```
gaatccattgttgatttttgactgtatatgaagttcttatcaatttccgagatgactata
catataaatgattaccatattatggtcagaaattgtataacagtgttagaatattctgtg
aagactttttttaacacaatattctgtgaagactagatatcatgtacttctccttgttttc
ttgacctgatgtccttcgtcacatgttgtgctcctcacaaaaaaatagcaagcacatgtt      3600
tcaaataattgttaataatataatttagcctttaatttatatggttctattttgagatat
ttttgtagtccaacttatatatttgtgactattctcaaaaacaaaacttatatatgtgtg
cctctcaaatgtagGGAGTGTTCTTGGAATGGCAAACTGGGTCCGCATTACTTTTGCTTG
               G  S  V  L  G  M  A  N  W  V  R  I  T  F  A  C
```

```
TGTTCCATCTTCTCTTCAAGATGGTCTCGGAAGGATCAAATCATTCTGTCAAAGGAACAA
 V  P  S  S  L  Q  D  G  L  G  R  I  K  S  F  C  Q  R  N  K
```

```
GAAGAGAAATTCGAGCGATGATTGCTAGTTGTATATCTGACTGAAGCTGTAAATCATTCC
  K  R  N  S  S  D  D  C  *
CAGTATCCCCATCTATATCTTTCAATAAAATGGAACTTTTAGTTCTCTATGAATAGAAGT
```

```
CAACATCTCCTTGAATATGTTCTGGTTGTTGTGGCCTGGACGAAACATAGTGAATGTTAT
```

```
GTTAGTGAAGTTAcattggcgtcgaagatctttgaagttttttttttttttggggggggg
```

```
ggggggggggtgctttgatattactcttaagtacacgttctctcaagttatgtcaaagca
ctttgtaaacaattgtagatttggtatcatgatatggattaaactagtcagatacttggt      4200
aagcacaaaccctacctatgttaggctcactaaggtggcgtttggttcgagagagaggaa
ggatcagttgatgatatccccaatcatcgaagtaaatcatgtgttgttgctaccactttt
ctacaatcctagtagctgcatgcgttgagctactgatcaacaccactgcacaaccatatt
ctctgtgcaaaatcggcacccaaagattacatctcacagctgaagcaaccaccaaatttg
aagagaggaaccctcacaaagacctttgagtgccccccacaatgcatggttaggccgccg
tcgcaggccggagtggtcaccatgcggaccaacaccaactccaacgggggagcacgtcac
cgattactgaaattccccaaacaattcttaatttgtgaacaaaatttaaaaacaggaaca
atttttgaatttgtgaacaaatttttaaacgggtattcctgaacattttttcaaaattgt
gatcaaaattttaaaacgacttctttctcaaatttgagcaatatttaaaattataaaaaa
gttcaacaattttgaacttttttaaaaattagcgagaacattttgaaattctaaatatttt      4800
cgaatttggaacattttttctatttctgaacaaaaattgaaaatacgaacgtaatttgga
ataaattttggaaaatgcgatttttttgaaatttctgaacatattttgaaaaacaaaaaaa
ctttaaaaggtaaaataaaaataaaataaaaatagaaacataaaaataagcaaaaaaata
```

```
aaagaaatccgagaaaagccaactgggaatagcacatggaaaaacccagccgtccgccgc
actgtgtaaagctataagtgagccggcccaagcctcgtcgtctcatcataccctgtgcga
aaccccgacaattcgttgcactatgcggcgaataggcttttccaggagctcctgtcttcc
ggttatgggtcatttgcacacccctcctccacttgggccaggctattatactttttttcc
ttctttcgacctcacgttactacgccagtttagttttttggaagcgaccaaccggttttgt
gaaggttctagaaactcaaccatttttgggaagcttctagaagcctatgaatgtttcttt
tggacatgtattatttgtgttttttcttttttcaaattgcacaatctttttttcaaattcat 5400
gatttttgtgaaacttgtgatttttttgaatccgtgattttttttcctaaatccgtgtttt
gaaaaaaactgtggacttttccgaaattaatgaacatttgtttgcaagatcgatgatcct
tttcaaatgagcgatttttttctaaaatatccacatattttttcatattcataagctttcc
ttttaatcgtgaactatcttagcatttggtgaactttttattaattttctttataaaatga
ttttttttcaaaagccaacggttaacggttgaccgctgaaccacaaccacaaaccggggga
aaccattgactcgctgaacagggcagggctttcatatgattgggtggtctaataccagcg
cccctgactactaaacgaaggaattgcaaatttttaccaaccactactatggtaaaaaatg
aatatcacgataaaaaaggggaaaaaaaactatacctgaaaatccctctgtttctaaat
atttgttgttggggagaactaatctgaaagaactaatctagttctccgcaataacaaata 6000
ttatgattcggggggagtataactattacacgatcaaccaaagaatgtcctccaagaaaa
acccaaagaaagtgctagagttttgtttttcaaggaccgaaagatagagatagcattctga
attaggtccatcttttttcccaaggattgaaagaaagagatagaattctgaattaggtgcg
gagatatcatttctggattaggtacaattgttttgccggcacagccaaaccccgcagtgg
agccggaattggaattgagtgggtggagtcgagaagcatggttcatgcgttctcaaagag
tgtagccagtagtgtgtgctccttggtgctggagctgcatatacaagtacataaaacaaa
gacgatcagctggcagcgtgcctgcatgcgtgcttcttgctgccgccccggaagccccgg
ttgatgtgcgcaggcgagtggcgacgggaccgacggctataaagcacggccaagcaccgc
cgccgttctcaatccatccatcccttagctgatttgATTGACTAGCTAGTTCATTCCCTG
```

```
CCACACTGCTAGTACTCCTCCTCGTTTCCTCGTGGCAATGGTACACCAGAGCAACGGCCA
                                    M  V  H  Q  S  N  G  H   NAAT-A
```

```
CGGCGAGGCCGCCGCCGCCGCCGCCAACGGCAAGAGCAACGGGCACGCCGCCGCCGCGAA 6600
   G  E  A  A  A  A  A  A  N  G  K  S  N  G  H  A  A  A  A  N
```

```
CGGCAAGAGCAACGGGCACGCGGCGGCGGCGGCGGTGGAGTGGAATTTCGCCCGGGGCAA
   G  K  S  N  G  H  A  A  A  A  A  V  E  W  N  F  A  R  G  K
```

```
GGACGGCATCCTGGCGACGACGGGGGCGAAGAACAGCATCCGGGCGATACGGTACAAGAT
   D  G  I  L  A  T  T  G  A  K  N  S  I  R  A  I  R  Y  K  I
```

```
CAGCGCGAGCGTGGAGGAGAGCGGGCCGCGGCCCGTGCTGCCGCTGGCCCACGGTGACCC
   S  A  S  V  E  E  S  G  P  R  P  V  L  P  L  A  H  G  D  P
```

```
GTCCGTGTTCCCGGCCTTCCGCACGGCCGTCGAGGCCGAGGACGCCGTCGCCGCCGCGCT
   S  V  F  P  A  F  R  T  A  V  E  A  E  D  A  V  A  A  A  L
```

```
GCGCACCGGCCAGTTCAACTGCTACGCCGCCGGNNTCGGCCTCCCCGCCGCACGAAGgta
   R  T  G  Q  F  N  C  Y  A  A  G  V  G  L  P  A  A  R  S
```

```
acatttacagcttcaccgtaatgtatgcgtgagcatgcatgcgccggtttacttacgtgc
ccgccgctgttcttccccggtgcgttcaaaattttaaccttctataagtaccttataaaa
acaaacagCGCCGTAGCAGAGCACTTGTCACAGGGCGTGCCCTACAAGCTATCGGCCGAC
        A  V  A  E  H  L  S  Q  G  V  P  Y  K  L  S  A  D
```

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```
GACGTCTTCCTCACCGCCGGCGGAACTCAGGCGATCGAAGTCATAATCCCGGTGCTGGCC
 D  V  F  L  T  A  G  G  T  Q  A  I  E  V  I  I  P  V  L  A

CAGACTGCCGGCGCCAACATACTGCTTCCCCGGCCAGGCTATCCAAATTACGAGGCGCGA  7200
 Q  T  A  G  A  N  I  L  L  P  R  P  G  Y  P  N  Y  E  A  R

GCGGCATTCAACAAGCTGGAGGTCCGGCACTTCGACCTCATCCCCGACAAGGGGTGGGAG
 A  A  F  N  K  L  E  V  R  H  F  D  L  I  P  D  K  G  W  E

ATCGACATCGACTCGCTGGAATCCATCGCCGACAAGAACACCACCGCGATGGTCATCATA
 I  D  I  D  S  L  E  S  I  A  D  K  N  T  T  A  M  V  I  I

AACCCAAACAATCCGTGCGGCAGCGTTTACTCCTACGACCATCTGGCCAAGgttttgcat
 N  P  N  N  P  C  G  S  V  Y  S  Y  D  H  L  A  K

ccatgcatcctctgcctcgttgatcgaccggtctgtttgaacatagtatatggattgcgt
ttgctaatcgtgtgctgatgatgctgtttggttatcagGTCGCGGAGGTGGCAAGGAAGC
                                        V  A  E  V  A  R  K

TCGGAATATTGGTGATCGCTGACGAGGTTTACGGCAAACTGGTTCTGGGCAGCGCCCCGT
 L  G  I  L  V  I  A  D  E  V  Y  G  K  L  V  L  G  S  A  P

TTATCCCGATGGGCGTCTTTGGGCACATTGCCCCGGTCTTGTCCATTGGATCTCTGTCCA
 F  I  P  M  G  V  F  G  H  I  A  P  V  L  S  I  G  S  L  S

AGTCGTGGATAGTGCCTGGATGGCGACTTGGATGGGTGGCGGTGTACGACCCCACAAAGA
 K  S  W  I  V  P  G  W  R  L  G  W  V  A  V  Y  D  P  T  K

TTTTAGAGAAAACTAAGgtagctttagctccctatcattcttctcatatgctactgtggg
 I  L  E  K  T  K

gattagtattttttgctaaatttgtactgcctttgtttattcagATCTCTACGTCTATTAC  7800
                                             I  S  T  S  I  T

GAATTACCTTAATGTCTCAACGGACCCAGCAACCTTCGTTCAGgttagtctttggttctt
 N  Y  L  N  V  S  T  D  P  A  T  F  V  Q
gccctattttgctcatgtccctgtgttgcatgtcaaatgaccggcttcaagttagtatat
agagttttttgttaagtgtgaatgtcgaagtccaacatgatggaagaaagatacatctatt
tttagtcattccccttttgtttgtttgattccataaaataaataaacacaaagccagaacc
aactattgaatagaactattttttcttagaaaatatacattgtattttgagcatgccatat
tcttttcgatcaagtatgcaatatattaaaacttgcattgtactacgagtataccatgtt
gttaagaatttctttacctacaacaccttgtctcgcatcttcatattttgatatccttga
cattattgttctcttatgattcacacaacttaattatggatttttgtgctatcaaattgt
ttagGAAGCTCTTCCTAAAATTCTTGAGAACACAAAAGCAGATTTCTTTAAGAGGATTAT
     E  A  L  P  K  I  L  E  N  T  K  A  D  F  F  K  R  I  I

TGGTCTACTAAAGGAATCATCAGAGATATGTTATAGGGAAATAAAGGAAAACAAATATAT  8400
 G  L  L  K  E  S  S  E  I  C  Y  R  E  I  K  E  N  K  Y  I

TACGTGTCCTCACAAGCCAGAAGGATCGATGTTTGTAATGgtaagctaagcatagactta
 T  C  P  H  K  P  E  G  S  M  F  V  M
```

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```
cttttttaaggttaatctgggatctcagtgcatccaacaaacaatcaaatcaaaatataat
tatgttttgctatggatctttttgaagatgcatgcatttgaagaataatgaagagagttg
aaattattttaggactaatcttcctgatatcatttgtccattttttttgttattactgtaa
attggtaacactcaaatcatattacaaaaagtttcctcccattttttagtaagattgactt
cctttctataaccatgtattaacttccatgtaaacagGTCAAACTAAACTTACATCTTTT
                                        V  K  L  N  L  H  L  L


GGAGGAGATCCATGACGACATAAATTTTTGCTGCAAGCTCGCAAAGGAAGAATCTGTAAT
   E  E  I  H  D  D  I  N  F  C  C  K  L  A  K  E  E  S  V  I


TTTATGTCCAGgtaggaatgtatatggccattttaaaggaaaactatatggaataataat
   L  C  P


atcttcttgttatactaaacaatacttcctccatcctaaaataaatgtcttacacttagc
acaattttatactagatctagtacaaagttgaaacagttattttgggacagagggagtag  9000
tatatattgtgtgagaacataaggttatgtttgactgatatatgcttcttaaatgtgaaa
catgttctcttatgttttttgattgtatacgaagttcttatcagtttccgagatgactac
acataaatgattaccatatcattgtcagaaaatgtattaccacattagaatattctttct
ttttatgcaaagactagcatggcatgtacttttccttgtacctatgtgtctttttttttc
tcgttacatgtttgtgcttctcacaaaaataataataccaagcacatgttccaaatgatt
attaataattttgaggtgttttttcaaccaacttatatactttcatagttctaaaaaaacc
gtatatatggttaactctaacaaaaacttatatatgttttctctctaatacagGGAGTGT
                                                        G  S  V


TCTTGGAATGGAAAATTGGGTCCGTATTACTTTTGCCTGCGTTCCATCTTCTCTTCAAGA
   L  G  M  E  N  W  V  R  I  T  F  A  C  V  P  S  S  L  Q  D


TGGACTCGAAAGGGTCAAATCATTCTGTCAAAGGAACAAGAAGAAGAATTCTATAAATGG
   G  L  E  R  V  K  S  F  C  Q  R  N  K  K  K  N  S  I  N  G


TTGTTAGTTGTACACACCCCTAGTTGTACATCTGACTGAAGCTGTAAATCATTTCTAGTT  9600
   C  *
ATCCCCATTTATATATTTCAATAAAACATATTGTAATGGTTCTGTTGTAGCTGTCCAAGT


CATGTACTCTACTTTTTGATGTATTTGGCCTCATTGCCTTGCATCAGTTTCAATAAAAAT


GGTTGTGTACACaatgatgatgtagaggcgaggtgttttgaccacctttttcaacaaaaat


ctatatctttcaacaaatgaaaccttgagttccctttgagtagaagtcaacatactcctt
gaatatgctatggtttccatggtctggatgaaacatgatgaatagaagtgaagttatatc
catgtcaaagttttttaatgtttaatttcattatgagaactttgatattacttctagcac
acattctctgaagtaattgtcagtttggtacttgaagggacctatattttttcctattggg
ggggggggggtgaataggcggtttataaccaattgtatatttgagaatatcttaatgtgga
attaaactaggtgaatattttttccaataaagggtgcttttattgactcacaatgtacca
tcaagggatacaatcataatgagtacacaatcgacatctacataatcaggttgcatacgg  10200
ccaacacacacacgcacacacacattcacacacacaaatcatgctgacgaagagcgaa
gtcatacaagatcaaaactatgcctaggcggaggaagaatagaaaaacatgaagaaatga
aaaaccgtgactgacaacatactgaccatcgacgacaaacatctgtagacaacacaaaaa
ctgcgagaaaagttctataaaactggcgccttcgagaaggaaacgacgtgcaagagttgc
catcatcggatccaaccactaaggtcatatcctgggttttcatcctgaagatcaaatccg
agcaaactccgagtaatgtctttattagggtaacgattcaaaaaatgccacaatcatgag
```

```
ttatgaccaattagaccagacctaggatttttatccaaagctcgagacgggtactctaga
agtaccatccaattgaagtcatcccacttgcctcaatacaaatagttgcatagatgcacg
gtccatatggcgagtaatggacatgagcgcgcatgtgtaggttaacgtgacgtgacaaga
gcctgtcgccaccactcgacgaagtgtttgatggggaggaagaagtatggctccaccaac 10800
atcccaagtttgaaacattctagagcccccttaccatactcacaaagcgacaattgatgac
tatctgtatcagacgacaaatccatgtccgtcactcgctctatcttggtcattgacatac
tacctggcaaaggcggattcaagccccagacagcctgggcggccgc
```
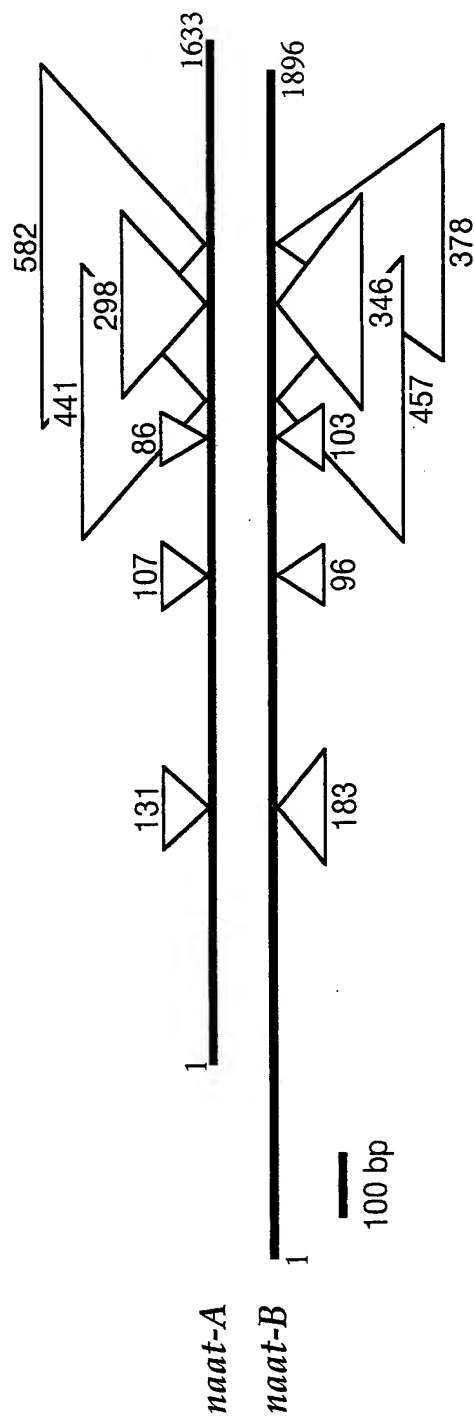
F I G. 11

naat-B exon

naat-A exon

E: EcoRI, H: HindIII, B: BamHI.
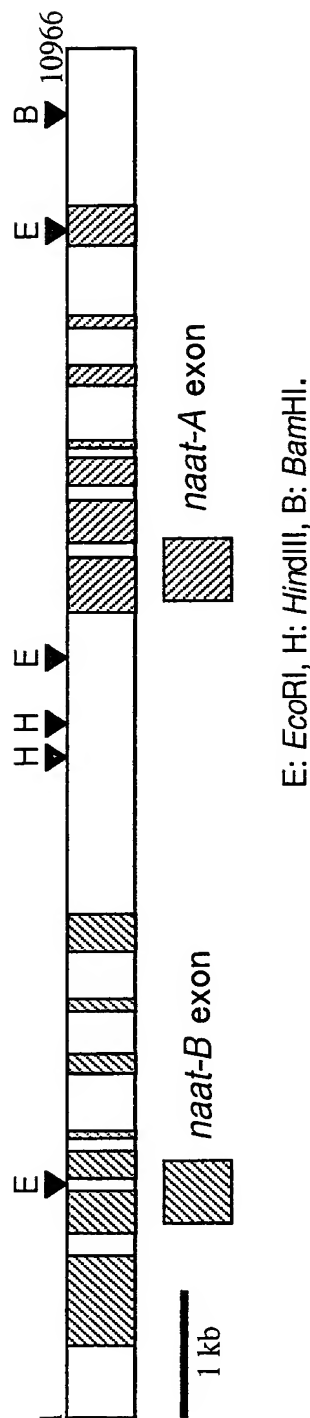
A schematic view of the obtained genome fragment

1 kb

10966

F I G. 1 2

FIG. 13

MVHQSNGHGEAAAAAANGKSNGHAAAANGKSNGHAAAAAVEWNFARGKDGILATTGAKNS
IRAIRYKISASVEESGPRPVLPLAHGDPSVFPAFRTAVEAEDAVAAALRTGQFNCYAAGV
GLPAARSAVAEHLSQGVPYKLSADDVFLTAGGTQAIEVIIPVLAQTAGANILLPRPGYPN
YEARAAFNKLEVRHFDLIPDKGWEIDIDSLESIADKNTTAMVIINPNNPCGSVYSYDHLA
KVAEVARKLGILVIADEVYGKLVLGSAPFIPMGVFGHIAPVLSIGSLSKSWIVPGWRLGW
VAVYDPTKILEKTKISTSITNYLNVSTDPATFVQEALPKILENTKADFFKRIIGLLKESS
EICYREIKENKYITCPHKPEGSMFVMVKLNLHLLEEIHDDINFCCKLAKEESVILCPGSV
LGMENWVRITFACVPSSLQDGLERVKSFCQRNKKKNSINGC*

FIG. 14

ATVRQSDGVAANGLAVAAAANGKSNGHGVAAAVNGKSNGHGVDADANGKSNGHGVAADAN
GKSNGHAEATANGHGEATANGKTNGHRESNGHAEAADANGESNEHAEDSAANGESNGHAA
AAAEEEEAVEWNFAGAKDGVLAATGANMSIRAIRYKISASVQEKGPRPVLPLAHGDPSVF
PAFRTAVEAEDAVAAALRTGQFNCYPAGVGLPAARSAVAEHLSQGVPYMLSADDVFLTAG
GTQAIEVIIPVLAQTAGANILLPRPGYPNYEARAAFNRLEVRHFDLIPDKGWEIDIDSLE
SIADKNTTAMVIINPNNPCGSVYSYDHLSKVAEVAKRLGILVIADEVYGKLVLGSAPFIP
MGVFGHITPVLSIGSLSKSWIVPGWRLGWVAVYDPRKILQETKISTSITNYLNVSTDPAT
FIQAALPQILENTKEDFFKAIIGLLKESSEICYKQIKENKYITCPHKPEGSMFVMVKLNL
HLLEEIDDDIDFCCKLAKEESVILCPGSVLGMANWVRITFACVPSSLQDGLGRIKSFCQR
NKKRNSSDDC*

FIG. 15 A

FIG. 15 B

Control naat

24/25

F I G. 1 6

rice transformed with *naat*

control rice

(cm)

Height of each rice

100

80

60

40

20

30   40   50   60   70   80   90

100

80

60

40

20

30   40   50   60   70   80   90   (days)

Number of days after a transplanting to alkaline soil